MANIPAL INSTITUTE OF TECHNOLOGY



Time: 3 Hours

* (A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2018

SUBJECT: AERODYNAMICS OF ROCKETS AND MISSILES [AAE 4001]

REVISED CREDIT SYSTEM (26/12/2018)

MAX. MARKS: 50

(03)

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- **1A.** Classify the missiles on the basis of their warheads.
- **1B.** As the slenderness ratio increases, drag on the forebody decreases: Justify **(03)** your answer with examples.
- 1C. Explain the laser guidance and inertial guidance systems with neat sketches. (04)
- 2A. Differentiate between ogival forebody and hemispherical forebody. (03)
- **2B.** Analyse the forces acting on a missile while passing through atmosphere. **(03)**
- **2C.** Establish the relationship between the drag coefficient of a conical forebody **(04)** and a blunt forebody.
- **3A.** Derive and prove that normal force coefficient is inversely proportional to **(03)** mach number with the help of linearized theory.
- **3B.** Develop an expression for the effect of acceleration on the rate of climb of a **(03)** missile.
- **3C.** A cruise missile with a weight of 10000N and a wing area of 10 m² has a drag (04) polar given by $C_D=0.0017+0.006C^2_L$. It accelerates under standard sea level conditions from a velocity of 150 m/s to 270 m/s. Develop an expression for drag acting on the missile. Also obtain the distance covered and time taken during the acceleration, assuming the thrust output to remain roughly constant at 7000N.
- **4A.** Generate the equations of motion for flight along a curved path in a vertical **(03)** plane (loop).

- **4B.** Describe the concept of translation, magnification and rotation in conformal **(03)** mapping.
- **4C.** Explain the process of obtaining cambered airfoil from circle using joukowski **(04)** transformation.
- **5A.** Write a short note on DATCOM related to missile aero prediction codes. **(03)**
- **5B.** Explain the significance of empirical methods in developing missile prediction **(03)** codes.
- **5C.** Define load factor. What are its values in (a) Level flight (b) Free fall (c) In a **(04)** turn of radius 200m at a aped of 100m/s (d) At the bottom of a loop of radius 200m at a speed of 100m/s.